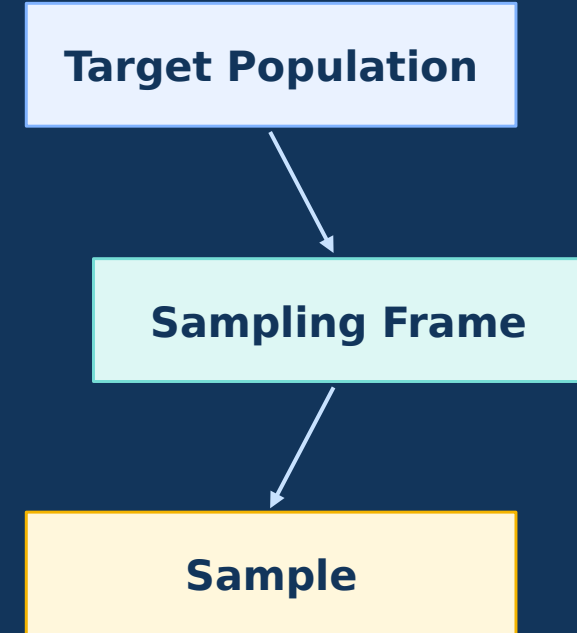


Population and Sample in Research

A student-friendly lecture on defining populations, selecting samples, and reporting sampling decisions in academic research.



Author: Muhammad Hassan
Website: ResearchMethod.net

Lecture Overview

OVERVIEW

What this lecture covers and how the ideas connect.



- Meaning of population, sample, sampling frame, unit of analysis, parameter, and statistic
- Major probability and non-probability sampling approaches
- Step-by-step procedure for selecting and describing a sample
- Practical examples, ethics, classroom activity, knowledge check, and references

Learning Objectives

OBJECTIVES

After this lecture, students should be able to:

- Define population, target population, accessible population, sample, sampling frame, and sampling unit.
- Distinguish between census and sample-based research.
- Compare probability and non-probability sampling methods.
- Select an appropriate sampling approach for a given research question.
- Explain how sample size is influenced by design, precision, resources, and analysis needs.
- Identify common sampling errors, biases, and ethical concerns.
- Write a clear population and sample section for a research methodology chapter.

**Measurable outcomes
for research design**

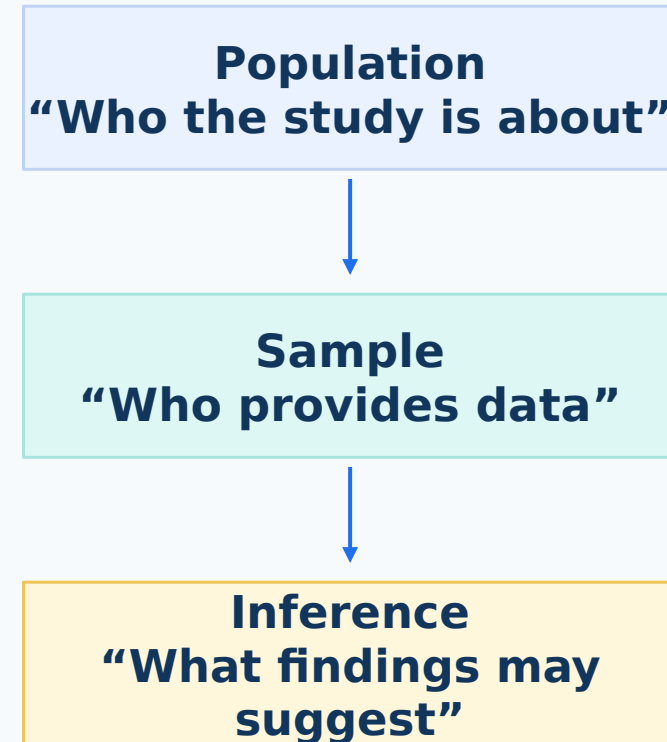
**Correct terminology
+ practical
application**

Why Population and Sample Matter

Sampling decisions shape the scope, credibility, and interpretation of research.

In most studies, researchers cannot collect data from every member of a population. Instead, they select a smaller group called a sample and use the data to answer research questions.

A strong sampling plan explains exactly who the study is about, who is actually included, how participants or cases are selected, and what limits apply when interpreting results.



Key Definitions

KEY TERMS

Essential vocabulary for understanding population and sample.

Term	Student-friendly meaning
Population	The entire group of people, cases, events, documents, or units the researcher wants to understand.
Target population	The full group the researcher ideally wants to generalize to.
Accessible population	The part of the target population the researcher can realistically reach.
Sample	The selected subset of the population from which data are collected.
Sampling frame	A list or source that identifies the units from which the sample is drawn.
Sampling unit	The individual case selected at one stage of sampling, such as a student, school, household, or record.

Background and Academic Context

CONTEXT

Sampling developed because research often studies large, dispersed, or hard-to-reach populations.

- Census thinking: early official statistics often aimed to count entire populations.
- Survey sampling: probability theory made it possible to estimate population characteristics from selected cases.
- Social research: sampling became central to surveys, experiments, interviews, observations, and document analysis.
- Modern research: online panels, administrative data, big data, and mixed methods require careful population boundaries.

The key academic question:

“Do the selected cases adequately represent the population or fit the purpose of the study?”

Target Population vs Accessible Population

DISTINCTION

The group you want to study is often broader than the group you can actually reach.

Target Population

- Broad ideal group the researcher wants to understand.
- Used when discussing generalization and study scope.
- May be national, global, or institution-wide.
- Example: all undergraduate students in Pakistan.

Accessible Population

- Realistic group available to the researcher.
- Affected by access, permissions, geography, time, cost, and language.
- Often narrower than the target population.
- Example: undergraduate students at three selected universities.

Sample, Participants, Respondents, and Units

SAMPLE

Different labels are used depending on the research design and data source.

Concept	Meaning	Example
Sample	The selected subset used for data collection.	200 students selected from a university.
Participant	A person who takes part in a study.	Interviewed teachers in a qualitative study.
Respondent	A person who answers a survey/questionnaire.	Employees completing a job satisfaction survey.
Sampling unit	The unit selected during sampling.	Household, school, patient record, article, website.
Unit of analysis	The entity about which conclusions are made.	Individual students, classrooms, companies, or countries.

Important: the sampling unit and unit of analysis are related, but not always identical.

Sampling Frame and Eligibility Criteria

FRAME

A sampling frame connects the abstract population to the cases that can actually be selected.



- A good frame is current, complete, relevant, and free from duplicate or ineligible entries.
- Inclusion criteria specify who may participate or which cases qualify.
- Exclusion criteria specify who or what must be left out for methodological, ethical, or practical reasons.
- Frame problems can create coverage error: some members of the population have no chance of selection.

Census vs Sample

COMPARISON

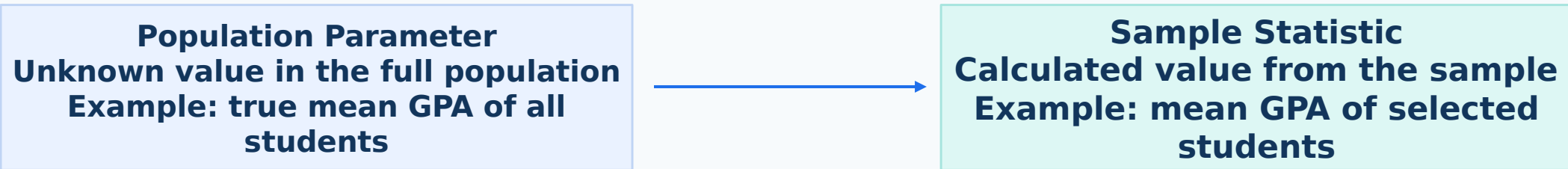
Researchers either study every eligible unit or select a subset.

Feature	Census	Sample
Meaning	Data are collected from every member of the population.	Data are collected from a selected subset of the population.
Best when	Population is small, accessible, and important to count completely.	Population is large, dispersed, costly, or time-consuming to study fully.
Strength	No sampling error if all eligible units are measured accurately.	Faster, cheaper, manageable, and often enough for inference.
Challenge	Can be expensive, slow, or impossible.	Requires careful design to reduce error and bias.
Example	Surveying all 45 employees in one department.	Surveying 400 customers from a database of 50,000.

Population Parameters and Sample Statistics

INFERENCE

Samples are often used to estimate unknown population values.



Researchers use sample statistics to estimate, test, compare, and interpret population parameters. The quality of this inference depends on design, sample size, measurement quality, and bias control.

- Parameter: population mean, proportion, variance, correlation
- Statistic: sample mean, sample proportion, sample standard deviation

Sampling Error, Bias, and Representativeness

QUALITY

A sample is useful only when its limitations are understood and managed.

Issue	What it means	How to reduce it
Sampling error	Natural difference between sample results and true population values.	Use suitable design and adequate sample size.
Selection bias	Some units are more likely to be included for non-random reasons.	Use clear procedures and avoid convenience-only claims.
Coverage error	The sampling frame does not cover the whole population.	Check and update the frame; document gaps.
Nonresponse bias	Selected participants differ from those who do not respond.	Follow up, simplify instruments, compare respondents and nonrespondents.
Representativeness	The sample reflects important characteristics of the population.	Match design to population structure and research purpose.

Types of Sampling: Probability vs Non-Probability

TYPES

The major classification depends on whether selection chances are known.

Feature	Probability sampling	Non-probability sampling
Selection principle	Each eligible unit has a known, non-zero chance of selection.	Selection chance is unknown or based on judgment, access, or referral.
Typical purpose	Statistical generalization and estimation.	Exploration, depth, access to specific cases, or practical constraints.
Examples	Simple random, systematic, stratified, cluster.	Convenience, purposive, snowball, quota.
Strength	Supports stronger claims about representativeness.	Flexible and useful when probability sampling is impractical.
Limitation	Requires a suitable frame and resources.	Higher risk of selection bias and limited generalizability.

Simple Random and Systematic Sampling

Two basic probability techniques using a list of eligible units.

- Simple random sampling selects cases using a formal chance-based procedure.
- Systematic sampling selects every k th unit after a random start.
- Both require an accurate list of eligible units.
- Researchers should inspect list ordering to avoid hidden patterns.
- Stratification may be better when subgroup representation is important.

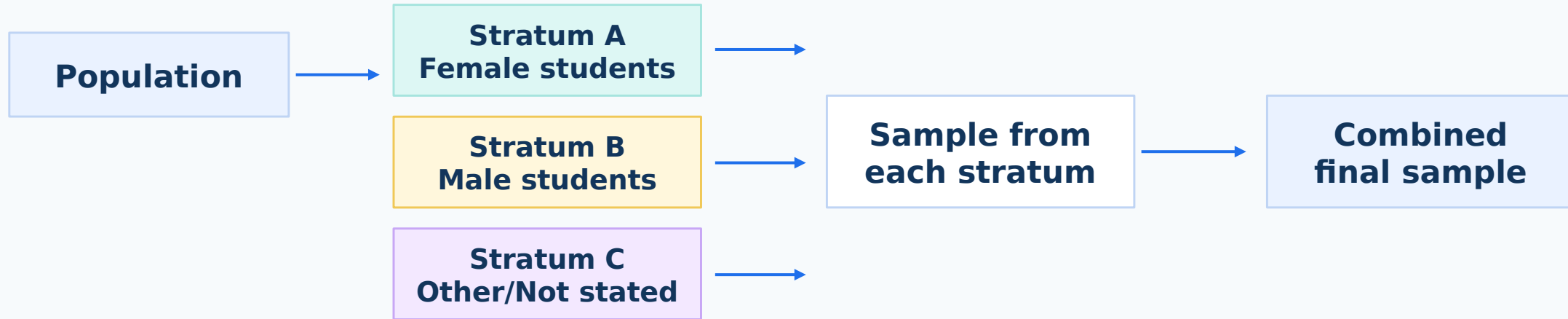
1	2	3	4	5	6
7	8	9	10	11	12
13	14	15	16	17	18

Selected cases form the sample.

Example: randomly select 120 students or select every 10th student after a random start.

Stratified Sampling

Divide the population into meaningful subgroups and sample from each subgroup.

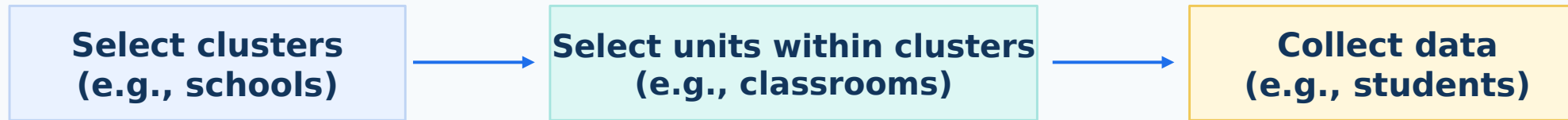


- Improves subgroup representation when relevant strata are known.
- Can use proportional allocation or intentionally oversample smaller groups.
- Requires accurate subgroup information in the sampling frame.

Cluster and Multistage Sampling

PROBABILITY

Useful when the population is naturally grouped or geographically dispersed.



Cluster Sampling

- Entire clusters or selected units in clusters are studied.
- Cost-effective for scattered populations.
- Members within clusters may be similar, affecting precision.

Multistage Sampling

- Selection occurs in two or more stages.
- Common in national surveys and large education/health studies.
- Requires clear reporting of each stage.

Convenience and Purposive Sampling

NON-PROBABILITY

Common approaches when access, depth, or specific expertise matters.

Convenience Sampling

- Selects cases that are easiest to access.
- Fast and low-cost.
- Useful for pilots or exploratory work.
- Risk: weak representativeness and selection bias.

Purposive Sampling

- Selects information-rich cases based on criteria.
- Common in qualitative research and expert studies.
- Requires transparent rationale for case selection.
- Risk: findings depend strongly on researcher judgment.

Snowball and Quota Sampling

NON-PROBABILITY

Useful for hard-to-reach populations or when subgroup targets must be filled.

Snowball Sampling

- Initial participants refer additional participants.
- Useful for hidden, specialized, or networked populations.
- Requires careful attention to privacy and coercion.
- May overrepresent connected networks.

Quota Sampling

- Researcher sets quotas for important characteristics.
- Helps ensure visible subgroup coverage.
- Selection within quotas may still be non-random.
- Used in market research and some field surveys.

Sample Size: What Determines It?

SIZE

Sample size should be justified, not guessed.

Research purpose

Description, comparison, prediction, exploration, or theory development

Population variability

More variation often requires a larger sample

Desired precision

Smaller margins of error require larger samples

Analysis plan

Subgroup tests and complex models require sufficient cases

Design and access

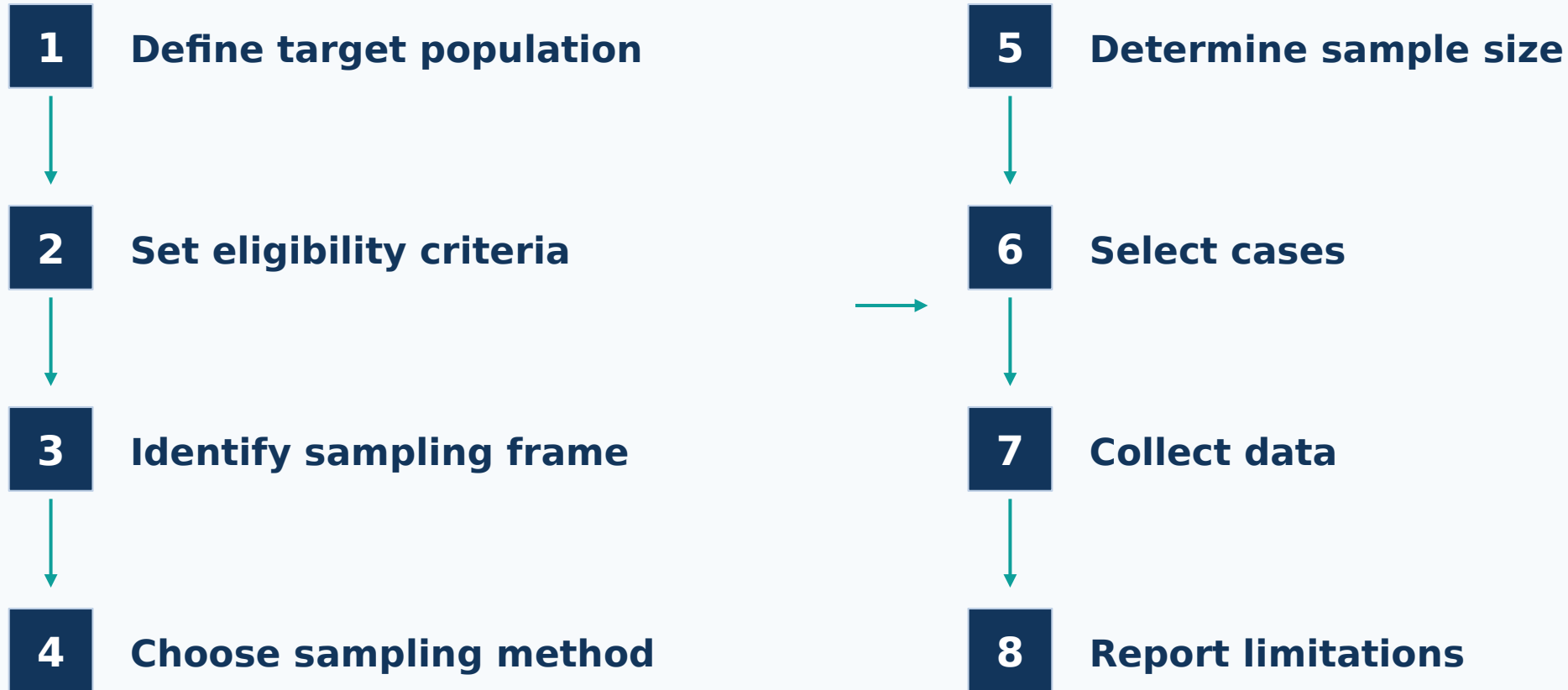
Cluster designs, response rates, time, budget, and ethics matter

Rule of thumb: match sample size to the research question, design, population, and planned analysis.

Step-by-Step Sampling Process

PROCESS

A clear sampling plan makes the method transparent and reproducible.



How to Report Population and Sample in a Methodology Section

METHODS

Good reporting allows readers to judge the credibility and limits of the study.

- State the target population and accessible population clearly.
- Describe inclusion and exclusion criteria.
- Identify the sampling frame or recruitment source.
- Name and justify the sampling technique.
- Explain the sample size and how it was determined.
- Describe recruitment, response rate, missing data, and final sample characteristics.
- Acknowledge limitations such as bias, coverage gaps, or restricted generalizability.

Example wording:

“The population consisted of full-time undergraduate business students enrolled at University X during Spring 2026. A stratified sample was drawn by year of study to ensure representation from each academic level.”

Practical Examples Across Disciplines

EXAMPLES

Population and sample decisions differ by field and study purpose.

Discipline	Population	Possible sample
Social sciences	Registered voters in a city	600 voters selected from electoral areas
Business & management	Employees of a multinational company	Stratified sample by department and job level
Education	Grade 10 students in public schools	Classes selected from 12 randomly chosen schools
Health sciences	Adult patients with type 2 diabetes	Eligible patients recruited from hospital clinics
Psychology	University students experiencing exam stress	Purposively selected students meeting screening criteria
Information technology	Small business websites in e-commerce	A sample of active websites meeting inclusion criteria

Detailed Research Scenario

APPLICATION

Applying population and sample concepts in a realistic study.

Element	Example
Research topic	Use of AI writing tools and academic writing confidence among university students.
Research problem	Universities need evidence on how students use AI tools and whether usage is linked to writing confidence.
Research question	What is the relationship between AI writing tool use and academic writing confidence among undergraduate students?
Population	Full-time undergraduate students enrolled at three universities during the 2026 academic year.
Sampling approach	Stratified sampling by university and year of study to improve subgroup representation.
Data collection	Online questionnaire with informed consent and anonymous responses.
Data analysis	Descriptive statistics, correlation, and comparison across strata.
Expected interpretation	Findings may suggest patterns among enrolled students at the three universities, not all students globally.

Advantages of Using Samples

Sampling makes many research projects practical and analytically useful.

STRENGTHS

- Reduces cost, time, and administrative burden compared with a census.
- Allows intensive data collection when the population is large or dispersed.
- Supports statistical estimation when probability sampling is properly used.
- Allows researchers to focus on specific groups, experiences, or cases of interest.
- Can improve data quality by allowing better training, monitoring, and follow-up.
- Makes pilot testing, fieldwork, and iterative research more manageable.

Efficient

Manageable

Focused

Analytically useful

Limitations and Challenges

LIMITS

Sampling creates practical and interpretive risks that must be managed.

- A sample may not accurately represent the population.
- Sampling frames can be incomplete, outdated, duplicated, or inaccessible.
- Nonresponse can distort results if nonrespondents differ from respondents.
- Small samples may reduce precision or make subgroup analysis unreliable.
- Non-probability samples limit statistical generalization.
- Recruitment barriers may exclude important voices or vulnerable groups.

A limitation is not a failure. It is a boundary that tells readers how the findings should and should not be interpreted.

Common Mistakes

MISTAKES

Frequent errors made by students and beginning researchers.

- Using “population” when only the accessible group is meant.
- Claiming random sampling without a genuine random selection procedure.
- Choosing a convenient sample but making broad generalizations.
- Ignoring inclusion and exclusion criteria.
- Failing to explain the sampling frame or recruitment source.
- Assuming a larger sample automatically removes bias.
- Reporting only the planned sample size but not the final analyzed sample.
- Using the wrong unit of analysis for the research question.

Best Practices

Practical recommendations for stronger sampling decisions.

PRACTICE

- Start with the research question before choosing the sampling method.
- Define the population with clear boundaries: who, where, when, and eligibility.
- Use probability sampling when statistical generalization is a major goal and a frame exists.
- Use purposive logic when depth, expertise, or specific cases are required.
- Justify sample size using design needs, analysis requirements, and practical constraints.
- Document recruitment steps, response rates, exclusions, and missing data.
- Be precise about the limits of inference and generalization.

Clear definition

Appropriate method

**Transparent
reporting**

Honest limitations

Ethical Considerations

Sampling is not only technical; it also affects fairness, privacy, and participant protection.

Ethical issue	Research responsibility
Informed consent	Participants should understand the study purpose, risks, benefits, and their right to withdraw.
Confidentiality	Protect identities, contact lists, referral chains, and sensitive subgroup information.
Fair inclusion	Avoid excluding groups without methodological or ethical justification.
Avoiding coercion	Recruitment should not pressure students, employees, patients, or referrals to participate.
Transparency	Report sampling procedures honestly; do not exaggerate representativeness.
Bias awareness	Consider whether access, language, technology, or gatekeepers shape who can participate.

Classroom Activity

ACTIVITY

Define a population and design a sample for a small research project.

Component	Activity details
Objective	Practice defining population, sample, sampling frame, sampling method, and limitations.
Instructions	In pairs, choose one topic: online learning, job satisfaction, exam stress, customer loyalty, or AI tool use. Define the target population, accessible population, sampling frame, sampling method, and sample size logic.
Output	Prepare a 2-minute explanation of the proposed sampling plan.
Expected outcome	Students should produce a clear and defensible sampling plan with one limitation and one ethical consideration.

Instructor tip: Ask each group to state exactly what population their results can reasonably represent.

Discussion Questions

DISCUSSION

Use these prompts for classroom conversation or reflection.

- Why is it risky to generalize from a convenience sample to a broad population?
- When might a non-probability sample be more suitable than a probability sample?
- How can a sampling frame create coverage error?
- What is the difference between a participant and a unit of analysis?
- How should researchers decide whether a sample size is adequate?
- What ethical issues can arise in snowball sampling?
- How can researchers report limitations without weakening their study?
- Which sampling method would you choose for your own research topic, and why?

Knowledge Check

CHECK

Answer individually, then compare with a partner.

- 1. What is the difference between a target population and an accessible population?
- 2. Which term refers to the list or source from which sample units are selected?
- 3. In simple random sampling, what must each eligible unit have?
- 4. Name two examples of probability sampling methods.
- 5. Name two examples of non-probability sampling methods.
- 6. Why can a large sample still be biased?
- 7. What is one ethical issue in recruiting participants through referrals?
- 8. In a study of schools and students, why might the sampling unit differ from the unit of analysis?

Knowledge Check: Answer Key

ANSWERS

Suggested answers for review.

- 1. Target population is the ideal group for generalization; accessible population is the group the researcher can realistically reach.
- 2. Sampling frame.
- 3. A known, equal chance of selection in simple random sampling.
- 4. Simple random, systematic, stratified, cluster, or multistage sampling.
- 5. Convenience, purposive, snowball, or quota sampling.
- 6. Bias can result from poor coverage, nonresponse, convenience selection, or systematic exclusion.
- 7. Privacy, confidentiality, pressure to participate, or disclosure of sensitive network information.
- 8. A researcher may select schools first but analyze data about individual students.

Key Takeaways and Conclusion

SUMMARY

Population and sample decisions connect research questions to credible evidence.

- Population defines the group, cases, or units the study is about.
- Sample identifies who or what actually provides data.
- Sampling frame and eligibility criteria determine who can be selected.
- Probability sampling supports stronger statistical generalization when properly implemented.
- Non-probability sampling can be appropriate for exploratory, qualitative, or hard-to-reach contexts.
- Every sampling choice should be justified, ethically handled, and transparently reported.

Conclusion
A well-designed sample does not simply make data collection easier. It defines the credibility, scope, and limits of the entire research project.

Best research claim: “Our findings apply to this defined population, with these sampling limits.”

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Thank You

Author: Muhammad Hassan
Website: ResearchMethod.net

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